REMARKS

Favorable reconsideration of this application is respectfully requested in view of the following remarks.

Claims 2, 4 and 8-30 are cancelled, and new Claims 31-43 are presented for consideration. Thus, the claims currently pending in this application are Claims 1, 3, 5-7 and 31-43. Claims 1, 31, 36 and 41 are the only independent claims.

Appreciation is expressed to Examiner Foreman for the indication that Claims 5 and 6 recite subject matter that patentably distinguishes over the prior art when considered in combination with the subject matter recited in independent Claim 1.

Examiner Foreman is also kindly thanked for taking the time to discuss this application and the outstanding issues during the telephonic interview conducted on February 26, 2009. The remarks below discuss the substance of the interview.

As discussed during the interview, the guide wire recited in independent Claim 1 comprises a first wire on the distal side of the guide wire, a second wire positioned proximally of the first wire and welded to the first wire at a welded portion having a projection. As claimed, the projection extends on both axial sides of the welded portion, and a cover layer is disposed over the projection. The first wire and the second wire are not helical coils, and a spiral coil covers at least the distal end portion of the first wire. In addition, the projection is such that material forming at least one of the proximal end of the first wire and the distal end of the second wire constitutes at least a part of the projection.

The Official Action sets forth a rejection of independent Claim 1 based on a combination of the disclosures in U.S. Patent No. 5,865,768 to Orr in view of the disclosure in Japanese Application Publication No. 11-0000737 to Toshiba. As

explained during the interview, Orr discloses a guide wire specifically constructed to include a radiopaque core segment covered by a radiolucent coil. The advantages associated with this construction are discussed in lines 27-41 of column 2 of Orr. More specifically, the disclosed guide wire 10 includes a core wire 20 possessing a radiolucent portion 25 and a radiopaque portion 30, and a radiolucent coil 15 encircling the distal portion of the coil wire 20. The patent states that the radiolucent portion 25 and the radiopaque portion 30 are attached by adhesive, welding, brazing, a pin or a screw at an attachment joint 40.

The Official Action takes the position that the radiopaque portion 30 of the core wire disclosed in Orr corresponds to the claimed first wire, while the radiolucent portion 25 of the core wire in Orr corresponds to the claimed second wire. The Official Action goes on to correctly note that Orr does not disclose a projection at the joint 40. The Official Action thus relies upon the disclosure in Toshiba. However, as explained during the interview, Toshiba also does not disclose first and second wires welded together at a welded portion configured as a projecting portion, let alone first and second wires of a guide wire welded together at a welded portion so that the welded portion includes a projecting portion.

Attached to this Amendment is an English language translation of Toshiba. As explained during the interview, Toshiba discloses a method of manufacturing a long wire rod from a plurality of shorter rod elements that are welded to one another. The process described in Toshiba begins with two wires each having a 6 mm outer diameter. The two rods are welded together at a welding device 12 shown in Figure 1 to produce an enlarged welded connection as shown in Figure 4 of Toshiba. Toshiba refers to this enlarged outer diameter welded connection as a nugget part

30. The welded wire is then conveyed to a grinding device 13 shown in Fig. 1 in which the enlarged outer diameter welded connection is reduced to an outer diameter of 7mm. Thereafter, the welded wire is heated in a heating device 14 shown in Figure 1, and is then subjected to further processing at a processing device 15 also shown in Figure 1. As discussed in paragraph [0049] of the translation, during the processing at the processing device 15, the outer diameter of the welded connection is reduced to 6 mm (i.e., the original outer diameter of the rod elements). This is discussed in paragraph [0049] of the translation. Thus, as explained during the interview, Toshiba does not disclose welding together first and second wires to produce a projection projecting in the outer peripheral direction on both axial sides of the welded portion, with a cover layer disposed over the projection. Indeed, Toshiba specifically describes removing (through grinding, heating and subsequent processing) the enlarged welded connection (the nugget part 30) so that the outer diameter of the entire wire is the same.

It is thus respectfully submitted that the disclosures in Orr and Toshiba fail to provide sufficient evidence establishing that the claimed guide wire at issue here would have been obvious to an ordinarily skilled artisan.

During the interview, the Examiner referenced the discussion beginning in paragraph [0041] of the English translation of Toshiba. The Examiner commented that this discussion seems to imply that the bonding strength at the welded portion can be improved by providing the enlarged welded portion. Thus, the Examiner asked the undersigned to consider whether this discussion in Toshiba is evidence that one of ordinary skill in the art would modify the joint 40 in Orr to include an

enlarged welded portion or projection as claimed. Several points should be noted on this topic.

First, while it is true that Toshiba mentions a relationship between the deformation amount of the welded part and the bonding strength of the welded part, it is also clear that Toshiba describes removing the nugget part 30. It seems unlikely that Toshiba's discussion about improving bonding strength by appropriately controlling the deformation amount means that the welded portion should be configured to include a projecting projection extending on both axial sides of the welded portion as claimed here. The reason is because Toshiba specifically describes removing the nugget part 30 -- if the description in Toshiba is intended to convey that the bonding strength of the weld is improved by configuring the welded portion with a projecting projection extending on both axial sides of the welded portion, it would be expected that Toshiba would keep the projection portion at the welded portion. Yet Toshiba specifically describes grinding, heating and further processing the nugget part 30. That Toshiba takes specific steps to remove the nugget 30 would indicate to an ordinarily skilled artisan that increased bonding strength is not dependent upon the presence of the nugget 30 in the end product. Otherwise, the nugget 30 would not be removed.

Perhaps Toshiba's reference in paragraph [0041] to the deformation amount of the welded part is a reference to the amount of deformation that occurs between the end portions of the two wires that are welded together -- that is the amount of material from the two wire ends that is melted (deformed) and intermixes with one another.

For at least the reasons discussed above, it is respectfully submitted that a combination of the disclosures in Orr and Toshiba fails to provide sufficient evidence establishing obviousness of the claimed guide wire at issue here. Accordingly, withdrawal of the rejection of independent claim 1 is respectfully requested.

New independent Claim 31 recites a guide wire comprising a first wire disposed on the distal side of the guide wire, and a second wire disposed on the proximal side from the first wire, wherein the first wire is made of a pseudo-elastic alloy and the second wire is made of a different material than the first wire. The second wire possesses an elasticity modulus greater than the elasticity modulus of the first wire. In addition, the first wire and the second wire are joined to each other by welding, and the welded portion formed by the welding has a projection projecting in the outer peripheral direction on both axial sides of the welded portion. A cover layer is disposed over the projection, and the first second wires are not helical coils. The welded surface of the welded portion at which the first and second wires are welded to each other is located at a maximum outer-diameter portion of the projection to disconcentrate stress to a smaller outer-diameter portion close to the projection. Further, a spiral coil covers at least a distal end portion of the first wire, and material forming at least one of the proximal end of the first wire and the distal end of the second wire constitutes at least a part of the projection.

This claim is patentably distinguishable over a combination of the disclosure in Orr and Toshiba for at least the same reasons discussed above because Claim 31 also recites the projecting projection formed by the weld. In addition, the cited references do not disclose the welded surface of the welded portion being located at a maximum outer-diameter portion of the projection for purposes of disconcentrating

stress to a small outer-diameter portion close to the projection as discussed in paragraph [0080] of the present application.

New independent Claim 36 is similar to Claim 1, and additionally recites that recites that the cover layer is in direct contact with the outer peripheral surface of the projection to cover the projection, and that the cover layer is a friction-reducing polymer material.

This claim is also patentably distinguishable over a combination of the disclosures in Orr and Toshiba for reasons similar to those discussed above in connection with Claim 1. In addition, Claim 36 recites that the cover layer is a friction-reducing polymer material and is in direct contact with the outer peripheral surface of the projection so as to cover the projection. Orr describes a plastic, silicone or hydrophilic coating covering the coil 15. There is no disclosure of a cover layer in direct contact with the joint 40. Nor would it have been obvious to provide a cover layer in such a manner since the cover layer would be covered by the coil 15 and would thus not be useful to impart friction-reducing qualities to the guide wire. Claim 36 is thus further allowable over a combination of Orr and Toshiba.

New independent Claim 41 is similar to Claim 1 and is thus allowable at least for the reasons discussed above in connection with Claim 1. In addition, Claim 41 set forth that the spiral coil covering at least the distal end portion of the first wire does not cover the projection, and further sets forth that the projection is not covered by a spiral-shaped wire.

Quite clearly, the connection joint 40 between the two portions 25, 30 is covered by the coil. Further, that construction is specifically intended as a part of the objectives sought to be achieved by the guide wire construction described in Orr.

Indeed, the presence of the coil 15 in covering relation to the connection joint 40 is a necessary and integral part of the overall guide wire disclosed in Orr. Thus, Claim 41 is further allowable over a combination of Orr and Toshiba.

The dependent claims are allowable at least by virtue of their dependence from allowable independent claims and so a detailed discussion of the additional distinguishing features set forth in the dependent claims is not presented at this time.

Early and favorable action concerning this application is respectfully requested.

Should the Examiner have any questions concerning this application or believe that a telephone conference with the undersigned would be helpful in resolving any remaining issues pertaining to this application, the undersigned respectfully requests that he be contacted at the number indicated below.

Respectfully submitted,

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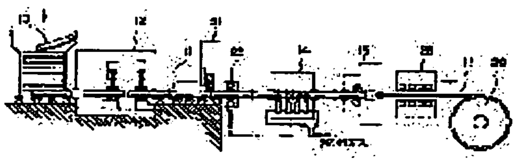
(54) APPARATUS FOR MANUFACTURING LONG WIRE ROD AND MANUFACTURE OF LONG WIRE ROD

(57)Abstract:

PROBLEM TO BE SOLVED: To efficiently manufacture a high quality long wire rod having high joined strength of a welded part over the whole length by continuously welding plural wire rod elements and working the welded part heated with a heating device at the working ratio in a specific range.



SOLUTION: The tip part of the long wire rod 11 is held with a wire rod conveying device 28 providing a rotary chuck and the long wire rod 11 is conveyed in the heating device 14 direction. Welded deforming part is detected with a welded part detecting instrument 23 arranged at the inlet side of the heating device 14, and an attached heating burner is ignited. Further, a switch of the heating burner is turned off after passing for a prescribed time with a timer. The long wire rod 11 heated with the heating device 14 is supplied into a working device 15 composed of roller dies and a swaging machine and worked at e.g. 26.5% (in the range of 5-50%) working ratio. The worked long wire road 11 is wound with a coiling drum 29.

[Claim(s)]

[Claim 1]A long wire rod manufacturing installation comprising:

Welding equipment which welds continuously the end faces of two or more wire rod elements to shaft orientations, and forms a long wire rod.

Heating apparatus which heats a weld zone.

A processing device into which a heated weld zone is processed by working ratio of 5 to 50%.

[Claim 2]The long wire rod manufacturing installation according to claim 1 being a butt-resistance-welding device characterized by comprising the following.
A profile and form tester with which welding equipment measures deformation of a weld zone.
A current limiter which carries out adjustment control of the welding current corresponding to the above-mentioned deformation.

[Claim 3]The long wire rod manufacturing installation according to claim 1 which is provided with the following and sets an axis of a long wire rod as being a roll-forging device (swaging machine) which carries out **** processing of the long wire rod with the above-mentioned dice from rectangular directions with the feature.
A rotary main spindle in which a processing device was held via two or more rollers in inner skin of a main part ring enabling free rotation.
Two or more dices which unite with a hammer and rotate with the above-mentioned rotary main spindle.

[Claim 4]A long wire rod manufacturing method processing a heated weld zone by working ratio of 5 to 50% after welding continuously the end faces of two or more wire rod elements to shaft orientations and heating a weld zone.
[Detailed Description of the Invention]
[0001]
[Field of the Invention]It is related with the long wire rod manufacturing installation whose dispersion in the characteristic this invention relates to a long wire rod manufacturing installation and a long wire rod manufacturing method, especially its bonding strength of a weld zone is large, and is able to stabilize for them and mass-produce few quality long wire rods, and a long wire rod manufacturing method.
[0002]
[Description of the Prior Art]When manufacturing the wire rod products which comprise refractory metals, such as tungsten (W) and molybdenum (Mo), a product yield is raised, and in order to raise productivity further, long picture-ization of the processing raw material is attained. In the processing raw material manufactured through a sintering process like especially the above-mentioned high-melting point metal material, the size of a processing raw material is restricted with the size of a firing furnace, etc. Therefore, in order to attain long picture-ization of a processing raw material, the process which carries out upset butt welding of the end faces of two or

more short processing raw materials, and is joined to shaft orientations becomes indispensable.

[0003]As welding equipment used in the above-mentioned welding process, Generally, the butt-resistance-welding device is used widely, according to the linear or cylindrical material kind of welding material (processing raw material), and the diameter, it compares, stress, welding current, etc. are managed, and these operation management items were set up based on the experience value from the former.

[0004]And the long processing raw material which welded and formed two or more processing raw materials is processed so that it may next have predetermined stepped surface shape with a forging device, and it turns into a long wire rod.

[0005]Drawing 9 is a sectional view showing an example of an above forging device, and is a sectional view showing the composition of the roll-forging device (swaging machine) 1 of 2 dice types. It unites with the rotary main spindle 4 held via two or more rollers 3 in the inner skin of the circular main part ring (cage) 2 enabling free rotation, and the hammer 5 and SIMM 6, and this roll-forging device 1 is provided with the two dices 7 which rotate with the above-mentioned rotary main spindle 4.

[0006]If it comes to the position of the roller 3 in the above-mentioned roll-forging device 1 while the hammer 5 rotates with the rotary main spindle 4, If it is located between the two rollers 3 and 3 with which the hammer 5 adjoins each other while the dice 7 is pressed in the direction of a center of rotation (the direction of a processing raw material), the dice 7 will be made a radius outside direction by the centrifugal force. Therefore, if the number of rotations of the rotary main spindle 4 is raised, **** forming by compression of the processing raw material 8 by the dice 7 is repeatable by high frequency.

[0007]In the above-mentioned roll-forging processing, the long wire rod which has various sectional shape can be formed by changing the tip shape of the dice 7 pressed by the work material. In the conventional roll-forging device, main part Ring 2 is being fixed so that it may have a predetermined inside diameter, and the cutting diameter of the long wire rod 8 was adjusted by changing the thickness of SIMM 6 infixed between the hammer 5 and the dice 7.

[0008]

[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional manufacturing installation, Since the bonding strength of the weld zone of the long wire rod which joined and formed two or more processing raw materials (wire rod element) is insufficient, In the subsequent work process, it was easy to produce the welding piece of a long wire rod, and a fracture, and since a plan substitute,

readjustment, etc. of each component were needed, there was a problem that the manufacturing yield and manufacturing efficiency of a long wire rod fell extremely each time.

[0009]Although various examination about the improvement measure of the above-mentioned bonding strength is made, as the improvement measure, optimization of the above welding conditions and optimization of a current pattern are most. However, there is also material in which weld strength sufficient by just optimization of the above-mentioned welding condition is not obtained, and a certain correspondence was needed.

[0010]That is, in the device, it was conventionally difficult not to be considered but for the difference in the processing history of a welding material (processing raw material) or a heat history and the difference in a size to make bonding strength of a weld zone high enough. When a butt-resistance-welding device was used as welding equipment, the contact state of the electrode of a welding machine and an electrode clamp changed easily, and there was a difficulty that dispersion in the bonding strength of a weld zone becomes large.

[0011]As shown in drawing 9 as a forging device, when the roll-forging device (swaging machine) using the main part ring in which the inside diameter was fixed is used, Once adjusting the cutting diameter of a long wire rod with SIMM, it is easy to expand thermally components, such as a dice, a hammer, and a roller, with the heat transmitted from a long wire rod. However, since the main part ring inside diameter is formed uniformly, the amount of [equivalent to the thermal expansion amount of the above-mentioned component] size fluctuations have influence directly to the processing outer diameter of a long wire rod. Since there was also no mechanism in which the size fluctuations by wear of component parts, such as a dice, a hammer, and a roller, are corrected, there was also a problem that it became difficult to mass-produce the long wire rod which has a fixed outer diameter in the state where it was stabilized.

[0012]This invention is made in order to solve the above-mentioned problem, and it is a thing.

It is providing the long wire rod manufacturing installation whose dispersion in the characteristic the bonding strength of the purpose of ** is large and is able to stabilize for them and mass-produce few quality long wire rods, and a long wire rod manufacturing method.

[0013]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, this

invention is characterized by a long wire rod manufacturing installation comprising the following.

Welding equipment which welds continuously the end faces of two or more wire rod elements to shaft orientations, and forms a long wire rod.

Heating apparatus which heats a weld zone.

A processing device into which a heated weld zone is processed by working ratio of 5 to 50%.

[0014]After a long wire rod manufacturing method concerning this invention welding continuously the end faces of two or more wire rod elements to shaft orientations and heating a weld zone, a heated weld zone is processed by working ratio of 5 to 50%.

[0015]As the above-mentioned welding equipment, a plane of composition (the end faces) of two or more wire rod elements is compared, and a butt-resistance-welding device which makes this plane of composition cause local melting, and welds a high current to it by resistance heating in a short-time sink and a plane of composition right-angled is used suitably.

[0016]If a wire rod element which comprises W and Mo is welded, recrystallization of a joined part organization will advance, big and rough-ization of a crystal will take place, a joined part will become weak, and it will be easy to produce breakage and breakage of a wire rod in a post process. Then, after heating a weld zone with heating apparatus, it is required to process it by predetermined working ratio, to carry out minuteness making of the crystalline structure of a joined part, and to toughen it.

[0017]As the above-mentioned heating apparatus, a flame burner device and a high frequency heating device can use it conveniently. Although the welded whole wire rod element may be sufficient as a heating object part, it is also possible to heat only a weld zone. Although heating apparatus **** cooking temperature changes with kinds of wire rod, when it is tungsten, it is about 900-1200 **. If this heating operation is not carried out, in the below-mentioned work process, it will become easy to fracture a weld zone of a wire rod.

[0018]A processing device also makes an allowable bending amount of a long-picture-ized wire rod increase while it makes an organization of a welding interface part interlock mutually and raises weld strength by processing a heated weld zone by working ratio of 5 to 50%. When too little [working ratio in the above-mentioned processing device / as less than 5%], an improvement effect of the above-mentioned weld strength and an allowable bending amount becomes insufficient. On the other hand, in being excessive, in a post process, it becomes easy for intensity to deteriorate in

a boundary part of a processing section of a wire rod, and a raw part, and to generate defects, such as a crack, so that working ratio may exceed 50%.

[0019]Although a forging apparatus, a rolling mill, a drawing device, etc. can be used as the above-mentioned processing device, in order to carry out **** wire drawing of the wire rod which comprises refractory materials, such as W and Mo, especially, a roll-forging device (swaging machine) as shown in drawing 9 is preferred.

[0020]By using a butt-resistance-welding device provided with a profile and form tester which measures deformation of a weld zone, and a current limiter which carries out adjustment control of the welding current corresponding to the above-mentioned deformation as welding equipment, As a result of always carrying out adjustment control of the welding current to an optimum value corresponding to size of deformation of a weld zone, a long wire rod whose bonding strength of a weld zone was fixed can be automatically mass-produced in the state where it was stabilized.

[0021]A rotary main spindle held via two or more rollers as a processing device in inner skin of a main part ring enabling free rotation, A long wire rod can be efficiently manufactured by uniting with a hammer, having two or more dices which rotate with the above-mentioned rotary main spindle, and using a roll-forging device (swaging machine) which carries out **** processing of the long wire rod with the above-mentioned dice from rectangular directions for an axis of a long wire rod.

[0022]A main part ring of a roll-forging device comprises two or more ring elements divided into a hoop direction, An outer diameter sensor with which a roll-forging device measures an outer diameter of a long wire rod after **** processing while a main part ring inside diameter is constituted by moving each ring element radially, enabling free adjustment, It may constitute so that it may have an adjusting device which controls a radial direction position of each ring element corresponding to a detection value from an outer diameter sensor, and adjusts a main part ring inside diameter.

[0023]Also in a case where according to the above-mentioned composition a dimensional change by thermal expansion of component parts, such as a dice, a hammer, and a roller, and a dimensional change by wear arose, and a difference is produced in an outer diameter of a long wire rod after processing, Since adjustment control is automatically carried out so that a radial direction position of each ring element may absorb outer diameter difference of the above-mentioned wire rod, it is stabilized and a long wire rod with an always constant outer diameter can be manufactured.

[0024]

[Embodiment of the Invention]Next, the embodiment of this invention is concretely described with reference to an accompanying drawing. Drawing 1 is a lineblock diagram

showing one example of the long wire rod manufacturing installation concerning this invention.

[0025]Namely, the long wire rod manufacturing installation concerning this example, The welding equipment 12 which welds continuously the end faces of two or more wire rod elements 10 to shaft orientations, and forms the long wire rod 11, It has the grinding attachment 31 which grinds the periphery of each weld zone, the heating apparatus 14 which heats the weld zone 13, and the processing device 15 into which the heated weld zone 13 is processed by the working ratio of 5 to 50%, and is constituted.

[0026]Here, the above-mentioned welding equipment 12 comprises a butt-resistance-welding device provided with the profile and form tester 16 which measures the deformation of the weld zone 13 as shown in drawing 2, and the current limiter 17 which carries out adjustment control of the welding current corresponding to the above-mentioned deformation. This butt-resistance-welding device is provided with the following.

The clamp chip 18 which grasps the wire rod elements 10 and 10 of the couple which countered shaft orientations, respectively.

The electrode 19 which supplies welding current to each wire rod elements 10 and 10.

The clamp cylinder 20 which opens and closes the clamp chip 18.

The matching pressurizing cylinder 22 which while clamped with the voltage setting equipment 21 which sets up welding voltage with the control signal from the current limiter 17, and presses the wire rod element 10 to the plane of composition of the wire rod element 10 of another side.

[0027]As heating apparatus, as shown in drawing 1, the flame burner type heating apparatus 14 which heats the weld zone of a long wire rod with the combustion heat of fuel gas is allocated. When it has the weld zone sensing device 23 which detects the weld zone of the long wire rod 11 and the detected weld zone moves it into the heating apparatus 14, this heating apparatus 14 is constituted so that a flame burner may be lit.

[0028]As shown in drawing 6 and drawing 7 other than a roller dice, the processing device 15, The rotary main spindle 4 held via two or more rollers 3 in the inner skin of main part Ring 2 a enabling free rotation, It unites with the hammer 5 and SIMM 6, and has two or more dices 7 which rotate with the above-mentioned rotary main spindle 4, and the roll-forging devices (swaging machine) 1a which carry out **** processing of the long wire rod with the above-mentioned dice 7 from rectangular directions are consisted of by the axis of the long wire rod 8.

[0029]Especially main part Ring 2 a of the above-mentioned roll-forging device 1a.

While a main part Ring 2 a inside diameter is constituted by comprising two or more ring element 2bs divided into the hoop direction, and moving each ring element 2b radially, enabling free adjustment, The roll-forging device 1a is provided with the laser type outer diameter sensor 24 which measures the outer diameter of the long wire rod 8 after **** processing, and the adjusting device 25 which controls the radial direction position of each ring element 2b corresponding to the detection value from the outer diameter sensor 24, and adjusts a main part Ring 2 a inside diameter, and is constituted.

[0030]Each ring element 2b which constitutes main part Ring 2 a is arranged in a circle via the slit 26. Each ring element 2b is being fixed to the collet-chuck part 27 radially opened and closed with the adjust signal from the adjusting device 25 by one. And it is constituted so that the inside diameter of main part Ring 2 a may be automatically adjusted with the switching action of the collet-chuck part 27.

[0031]The wire rod conveying machine 28 which conveys the long wire rod 11 processed with the processing device 15 as shown in drawing 1, and the wind drum 29 which rolls round the conveyed long wire rod 11 are allocated. As the above-mentioned wire rod conveying machine 28, it is possible to adopt a manual type or automatic all, or the automatic transferring machine which comprises a feed roller etc. can also be used.

[0032]The example which manufactured the long wire rod using the long wire rod manufacturing installation constituted as mentioned above is explained below. Hot working of the Mo sintered compact was carried out first, and the cylindrical wire rod element 10 6 mm in diameter was prepared. Next, butt welding was carried out using the butt-resistance-welding device 12 as shows drawing 2 each wire rod element.

[0033]Drawing 3 is a front view showing the shape of the wire rod element 10 before energization of a butt-welding device, and drawing 4 is a front view showing the shape after energization. After energization, the weld zone 13 softens and changes and the welding distortion part (nugget part) 30 is formed.

[0034]In this way, the long wire rod 11 which welded two or more two or more wire rod elements 10 to shaft orientations, and formed them is shown in drawing 10. A prescribed interval is set to the long wire rod 11, and the welding distortion part (nugget part) 30 is formed.

[0035]Next, the periphery of the welding distortion part 30 of the long wire rod 11 shown in drawing 10 was ground using the grinding attachment 31 shown in drawing 1, and the long wire rod 11 whose outer diameter of a grinding part is 7 mm as shown in drawing 11 was formed.

[0036]Next, the tip of the long wire rod 11 is held with the wire rod conveying machine 28 which equipped the rotational chuck, and the long wire rod 11 is conveyed in the

heating apparatus 14 direction. The weld zone sensing device 23 formed in the entrance side of the heating apparatus 14 detects the welding distortion part 30, and the attached heating burner is lit. The switch of a heating burner serves as OFF after predetermined time with a timer.

[0037]The long wire rod 11 heated by the heating apparatus 14 is supplied to the processing device 15 which comprises a roller dice and a swaging machine, and it is processed by the working ratio of 26.5% so that the outer diameter of a weld zone may be set to 6 mm from 7 mm. The processed long wire rod 11 is rolled round with the wind drum (spool) 29.

[0038]Thus, it was possible by welding a short length wire rod element to two or more and shaft orientations, and processing it by predetermined working ratio after heating the weld zone to have covered an overall length and to have manufactured efficiently a long wire rod with it. [high bonding strength of a weld zone and] [quality]

[0039]The bonding strength of the weld zone of the long wire rod manufactured by the long wire rod manufacturing installation of this example has improved substantially no less than 26% on an average as compared with the long wire rod manufactured with the conventional method of only grinding a welding distortion part. The amount of bending deformation also increased to about 5 times as compared with the former. Therefore, also when carrying out secondary elaboration of the long wire rod to small-gage wires, such as a filament, further, there were few occurrences of a crack and a disconnection accident, and the mass production nature of secondary ray material has been improved by leaps and bounds.

[0040]In the long wire rod manufacturing installation concerning this example, it has become clear by adjusting welding current especially corresponding to the amount of welding distortion in a welding process that a long wire rod with high bonding strength of a weld zone is obtained.

[0041]That is, the most important factor that affects the bonding strength of the weld zone of a long wire rod is the deformation of a weld zone. When carrying out butt welding of two or more wire rod elements like this example and manufacturing a long wire rod, the welding distortion part 30 as shown in drawing 4 is formed. It is clear by invention-in-this-application persons' research that the size of the yield of the new field in the interface of a welding distortion part influences bonding strength greatly here. That is, it is required for improving strength to make the yield of a new field increase.

[0042]the ratio of the outer diameter D of the welding distortion part (nugget part) 30 and the width W which are shown in drawing 4 here -- improving strength will be obtained, if welding current is adjusted so that the value of the above-mentioned ratio

delta may become the optimal range since delta (D/W) supports the yield of a new field. If welding current is small here, while delta will generally become small, delta will become large if welding current is high. However, since melting of material will be produced or it will be easy to start the debasement of the wire rod by big-and-rough-izing of a crystal grain if welding current is too high, it is necessary to determine the range proper about delta value.

[0043]The following welding processes were adopted in this example. That is, in the welding equipment shown in drawing 2, the wire rod element 10 is fixed by the clamp chip 18 by operating the clamp cylinder 20. Next, it compares, the pressurizing cylinder 22 is operated and the wire rod elements 10 and 10 of the couple which counters are compared. Next, by impressing the voltage set up by the voltage setting equipment 21 between the electrodes 19, it energizes to the wire rod elements 10 and 10, and welds by carrying out softening modification of the joined part by resistance heating.

[0044]Then, the shape (the path D and width (W) which are shown in drawing 4) of the welding distortion part (nugget part) 30 is measured with the profile and form tester 16. When this shape has separated from the predetermined size range, according to the control procedure shown in the flow chart of drawing 5, voltage is adjusted automatically and the following welding condition is amended.

[0045]That is, the outer diameter D and the width W of the welding distortion part (nugget part) 30 of the wire rod elements 10 and 10 which were welded with the profile and form tester 16 shown in drawing 2 as shown in drawing 4 are measured. When weldbonding of the wire rod elements 10 and 10 with a diameter of 6 mm which comprises tungsten (W) was carried out, it became clear that weld strength became large in 2.0-2.2 in the shape ratio delta of the outer diameter D of the above-mentioned welding distortion part 30 and the width W (=D/W). That is, the intensity of a joining interface increases as the shape ratio of the outer diameter D of the welding distortion part 30 and the width W becomes large. Although what is necessary is just to raise welding current in order to make intensity increase furthermore, when it raises too much, there is a tendency in which recrystallization happens easily by the rise in heat of the welding distortion part 30, and near an interface carries out embrittlement. Therefore, the range with the proper value delta of the above shape ratios exists.

[0046]The welding current in the welding equipment 12 is adjusted by controlling the voltage of the voltage setting equipment 21 according to the shape ratio delta of the above-mentioned welding distortion part 30. That is, in joining the wire rod element which grows, for example from W material 6 mm in diameter, as it shows in the flow chart of drawing 5, initial setting is carried out so that shape ratio $delta_0$ of the optimal

welding distortion part may be set to 2.0-2.2, and welding is performed with the welding voltage of 300V. And shape measuring of the welding distortion part by the profile and form tester 16 is performed, and the shape ratio delta of a actual welding distortion part is measured. If the above-mentioned shape ratio delta is restored to the predetermined range (2.0-2.2) here, welding operation of the welded place concerned will be ended (END). However, when the shape ratio delta becomes in less than a mentioned range, only 20V makes welding voltage rise to a pan, and welding is performed. On the other hand, when the shape ratio delta becomes excessive across a mentioned range, only 20V makes welding voltage descend, and upset butt welding is performed, controlling welding current.

[0047]According to the above-mentioned example, since welding current was controlled in the optimal range according to the shape of the welding distortion part of a long wire rod, the long wire rod which has the high bonding strength of each weld zone, and little dispersion in quality was able to be manufactured stably.

[0048]In the above-mentioned example, although welding current was adjusted based on the shape ratio delta detected from the outer diameter D and the width W of a welding distortion part, when current was adjusted based on the outer diameter D of the above-mentioned welding distortion part in simple, the long wire rod with little dispersion in strong was obtained. In this case, as for the outer diameter D of a welding distortion part, it is preferred to specify in the range of 11.5-12.5.

[0049]Since according to the long wire rod manufacturing installation concerning this example it is constituted so that the main part ring inside diameter of a roll-forging device (Suwayh zinc machine) can be adjusted to compensate for change of the outer diameter of the long wire rod after processing as shown in <u>drawing 6</u> and <u>drawing 7</u>, The size fluctuations by the thermal expansion and wear of a device component are absorbed effectively. Therefore, it is stabilized and the long wire rod with a constant outside diameter size which has little change of an outer diameter can be manufactured.

[0050]Namely, as shown in not the roll-forging device 1 that has main part Ring 2 to which the inside diameter was fixed as shown in <u>drawing 9</u> but <u>drawing 6</u>, and <u>drawing 7</u>, the processing device of this example device, Main part Ring 2 a is divided into two or more ring element 2bs via the slit 26, each ring element 2b is made into a collet-chuck method, and since it is constituted so that it may drive by the oil pressure mechanism or a motor mechanism, the cutting diameter of a long wire rod can be changed. That is, a processing device is provided with the following.

<u>The collet-chuck part 27 united with each ring element 2b as shown in drawing 6</u> and <u>drawing 7</u>.

The laser type outer diameter sensor 24 which measures the outer diameter of the long wire rod 8 after swaging processing.
The adjusting device 25 which controls the inside diameter of main part Ring 2 a of a collet-chuck type based on the outer diameter of the long wire rod 8 after processing.

[0051]After starting swaging processing of a long wire rod, the outside diameter measurement of the long wire rod 8 after swaging processing is started with the laser type outer diameter sensor 24, The difference between a target outer diameter and a real outer diameter is computed by the operation part of the adjusting device 25, the inside diameter correction value of main part Ring 2 a is further computed from this difference, it transmits to the collet-chuck part 27, and the radial direction position of the collet-chuck part 27 united with each ring element 2b is adjusted with an oil pressure mechanism or a motor.
[0052]For example, if the outer diameter of the long wire rod 8 becomes thin by the thermal expansion and wear of a dice, a hammer, a roller, etc. which constitute a swaging machine, by the calculation result in the operation part of the adjusting device 25, the collet-chuck part 27 is extended to the method of the outside of a radius, and extends the inside diameter of main part Ring 2 a. The cutting diameter (outer diameter) of the long wire rod 8 can always be uniformly held by repeating such a series of adjusting operation until processing equipment configuration entire components, such as a dice, a hammer, and a roller, reach supersaturation quantity of heat.
[0053]Drawing 8 is a graph which shows the relation between the processing number of a long wire rod, and the outer diameter of the processed long wire rod. In drawing 8, a dashed line shows the case where it is processed using the conventional roll-forging device which uses the stationary type main part ring shown in drawing 9, and the tendency for the outer diameter of a long wire rod to shift greatly in the time of a processing start and the second half of processing is observed.
[0054]On the other hand in drawing 8, a solid line shows the case where it is processed using the roll-forging device concerning this example which uses the main part ring which can adjust an inner diameter dimension as shown in drawing 6 and drawing 7, There is almost no change of the processing outer diameter of a long wire rod until it continues from a processing start in the second half of processing, and the wire rod with little dispersion in a size was obtained.
[0055]
[Effect of the Invention]Since according to the long wire rod manufacturing installation which starts this invention above as explanation the short length wire rod element was

welded to two or more and shaft orientations and it is processed by predetermined working ratio after heating the weld zone, an overall length can be covered and a long wire rod with it can be manufactured efficiently. [high bonding strength of a weld zone and] [quality] By adjusting welding current corresponding to the amount of welding distortion in a welding process, a long wire rod with high bonding strength of a weld zone is obtained.

[Brief Description of the Drawings]

[Drawing 1]The front view showing the composition of one example of the long wire rod manufacturing installation concerning this invention.

[Drawing 2]The sectional view showing the example of composition of the welding equipment used by this invention.

[Drawing 3]The front view showing the state of the wire rod element before energization of resistance welding equipment.

[Drawing 4]The front view showing the state of the wire rod element after energization of resistance welding equipment.

[Drawing 5]The flow chart which shows the control procedure of welding current.

[Drawing 6]The sectional view showing the structure of the processing device (swaging machine) used by this invention.

[Drawing 7]The sectional side elevation of the processing device shown in drawing 6.

[Drawing 8]The graph which shows the relation between the processing number of a long wire rod, and an outer diameter.

[Drawing 9]The sectional view showing the important section of the conventional roll-forging device (swaging MAKUSHIN).

[Drawing 10]The top view showing the shape of a long wire rod where the wire rod element was welded and acquired.

[Drawing 11]The top view showing the shape of a long wire rod where the welding distortion outside circumference was ground.

[Description of Notations]

1 Roll-forging device (swaging machine)

2 2a Main part ring (cage)

2b Ring element

3 Roller

4 Rotary main spindle

5 Hammer

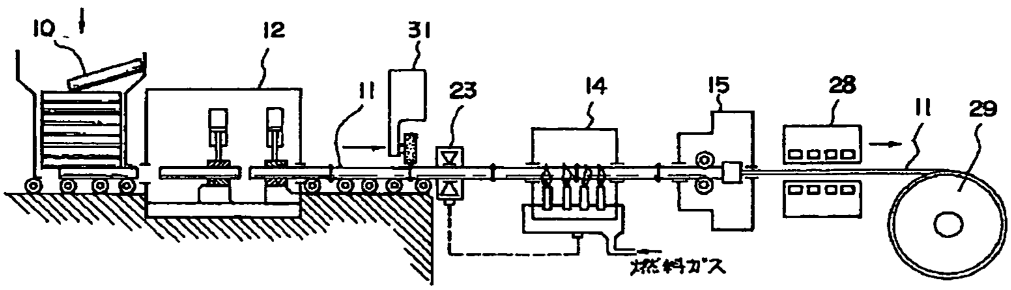
6 SIMM

7 Dice

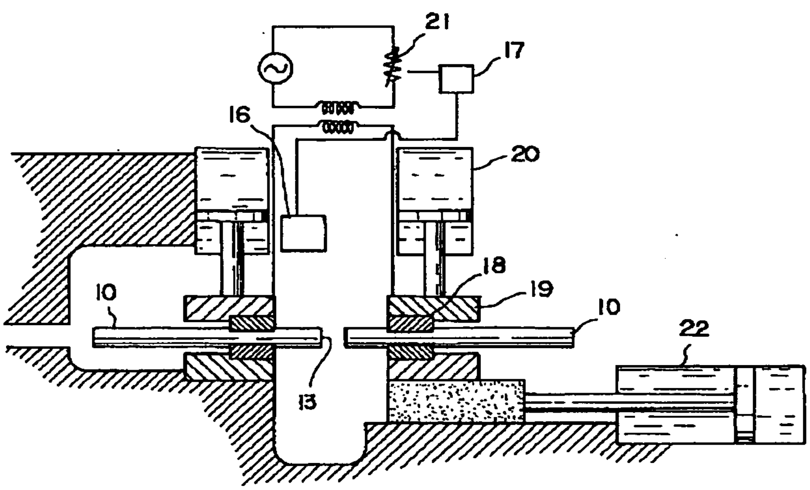
8 Processing raw material (long wire rod)
10 Wire rod element
11 A long wire rod
12 Welding equipment (butt-resistance-welding device)
13 Weld zone
14 Heating apparatus
15 Processing device (a roll-forging device, a swaging machine)
16 Profile and form tester
17 Current limiter
18 Clamp chip
19 Electrode
20 Clamp cylinder
21 Voltage setting equipment
22 Compare and it is a pressurizing cylinder.
23 Weld zone sensing device
24 Laser type outer diameter sensor
25 Adjusting device
26 Slit
27 Collet-chuck part
28 Wire rod conveying machine
29 Wind drum (spool)
30 Welding distortion part (nugget part)
31 Grinding attachment

DRAWINGS

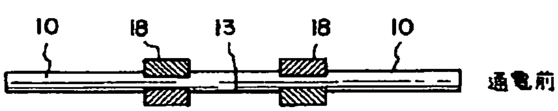
[Drawing 1]



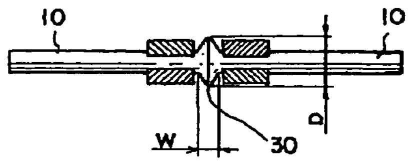
[Drawing 2]



[Drawing 3]



[Drawing 4]



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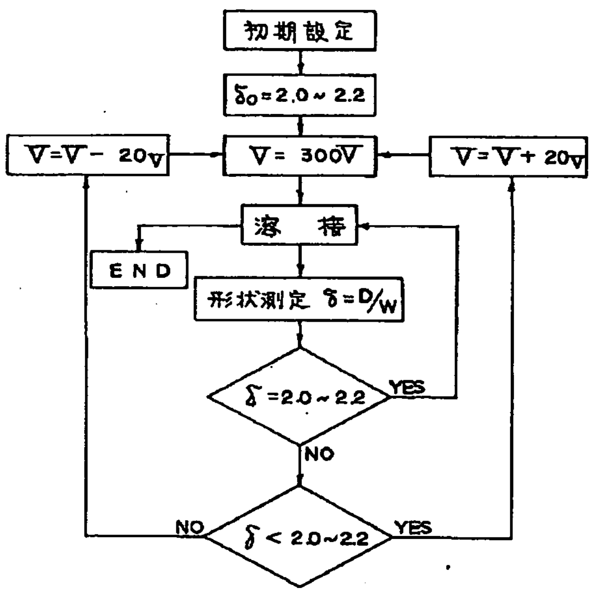
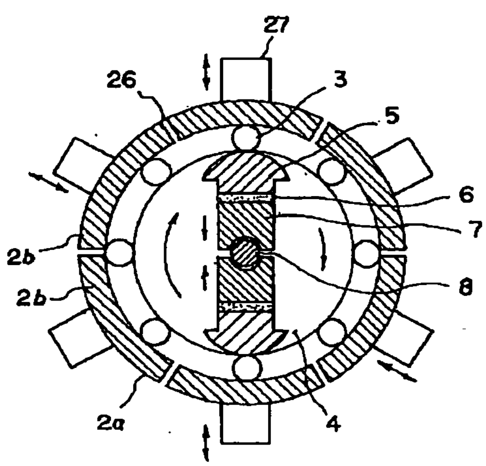
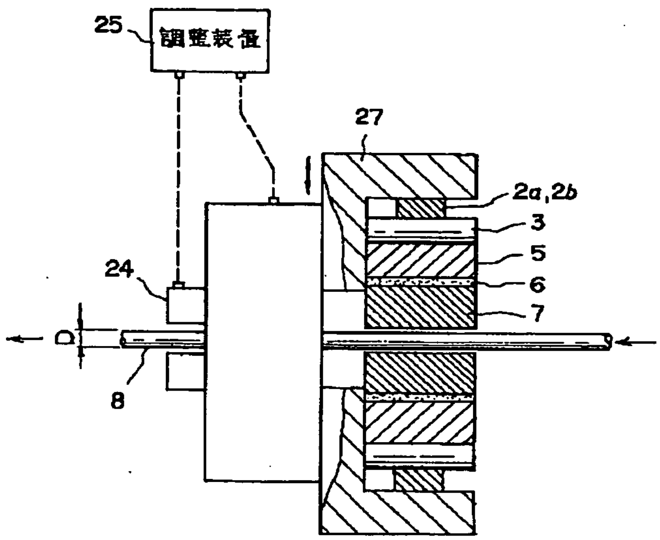
[Drawing 5]



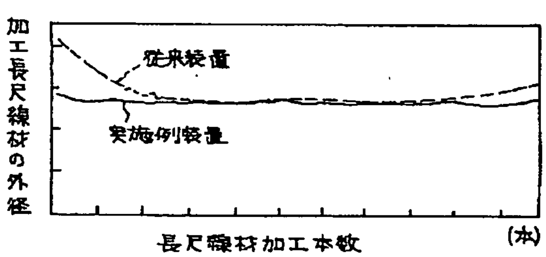
[Drawing 6]



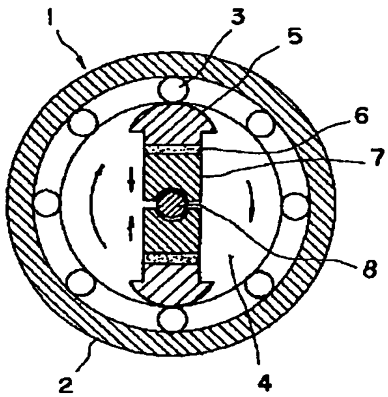
[Drawing 7]



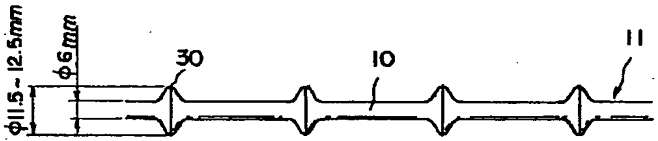
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Drawing 11]